Atomizer

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Abstract of **EP0855224**

An atomizer comprises an atomizer jet, the atomizer jet having a product outlet from which a product can be atomized, means for sourcing compressed air, a product reservoir., means for supplying the product from the reservoir to the outlet and a first chamber into which atomized product can diffuse. The atomizer includes means to prevent or stop the product from atomizing in response to a positive pressure in the atomizer.

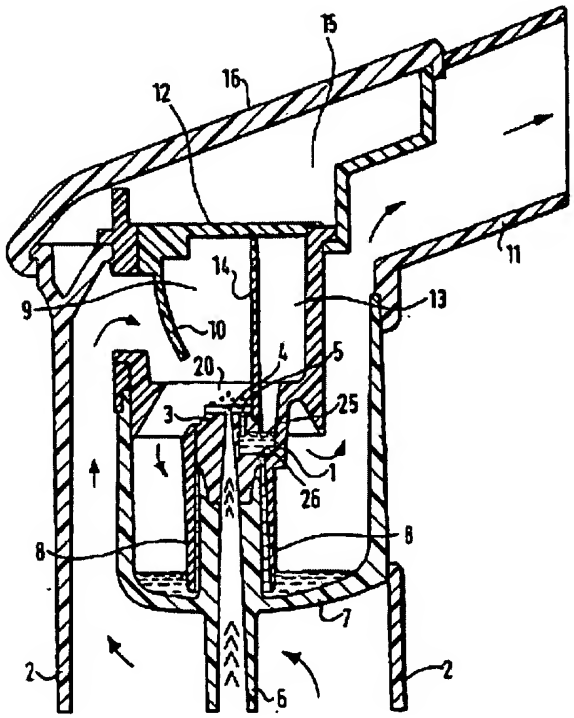

FIG.1.

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(54) Atomizer

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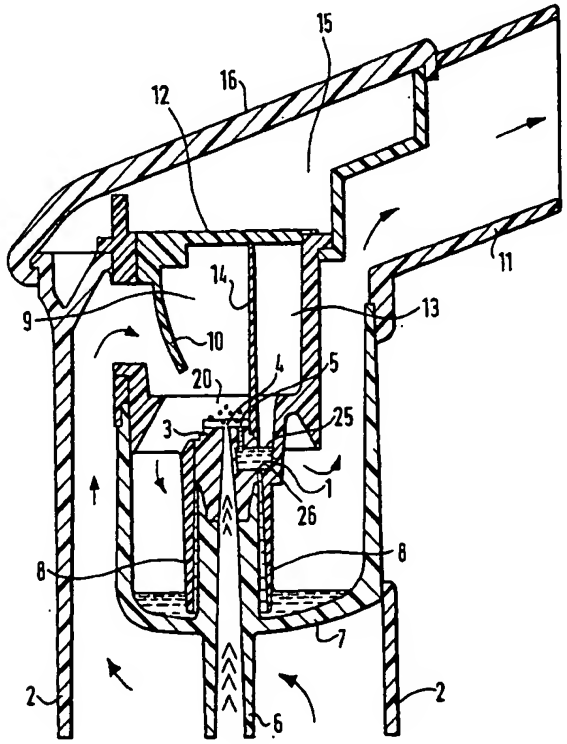

FIG.1.

EP 0 855 224 A2

Description

This invention relates to atomizers, in particular, atomizers for dispensing powders or liquids which are atomised by a stream of compressed air. Such atomizers may, for example, be used as medical atomizers for dispensing small quantities of medicaments.

Most conventional atomizers of the above type operate continuously whether atomization is required or not. Strictly speaking, when such atomizers, frequently called nebulisers, are used in medical applications, atomization is only required during the inhalation phase of a breathing cycle so that a drug can be administered by 'deposition in the lungs. In practice a patient usually inhales for about 30 percent of the breathing cycle, consequently, use of a continuously operating atomizer results in a large proportion of the atomised drug being wasted.

Some designs of medical atomizer overcome such wastage by giving the patient a manual trigger to start the atomization when they begin to inhale. Such a manual trigger controlled type of atomizer is not satisfactory since the patient must coordinate inhalation with trigger operation.

In one conventional atomizer a gas duct leads gas under pressure to a gas exit, a reservoir for holding the substance to be atomised is formed around the base of the gas duct, and a sleeve placed around the gas duct defines a passageway through which the substance to be atomised may pass to at least one outlet. A fixed deflector in the form of a bar is disposed in line with the gas outlet so that gas issuing from the gas exit is deflected so as to pass over the outlet or outlets. The passage of gas over each outlet draws the substance to each outlet. The deflected gas atomises the substance, and atomised particles of the substance are carried away by the stream of deflected gas, and are subsequently inhaled during the inhalation phase of the patient. Since the patient breathes air or gas in through the atomizer, but only inhales through part of the cycle, some of the drug is lost while the patient is not inhaling.

An example of such an atomiser system is to be found in EP-A-627,266 (Medic-Aid Limited).

In a first aspect of the invention there is provided an atomizer comprising an atomizer jet, the atomizer jet having a product outlet from which product can be atomized, means for sourcing compressed air, a product reservoir, means for supplying the product from the reservoir to the outlet and a first chamber into which atomized product can diffuse, characterised in that the atomizer has means to prevent or stop the product from atomizing in response to a positive pressure in the atomizer.

According to a further aspect of the invention, there is provided an atomizer comprising an atomizer jet, the atomizer jet having a product outlet from which product can be atomized, means for sourcing compressed air, a product reservoir, a means supplying the product from the reservoir to the outlet and a first chamber into which atomized product can diffuse, characterised in that the atomizer has located between the product outlet and the reservoir a secondary reservoir which is in fluid connection with a second chamber, the second chamber being operable in response to a positive pressure in the atomizer to drive fluid from the secondary reservoir.

In embodiments of the invention, it is preferred that the apparatus is one which generates atomized product when the pressure in the apparatus is atmospheric or less than atmospheric (i.e. negative), but that atomisation is prevented or stopped when the pressure in the apparatus is positive (i.e. greater than atmospheric).

In embodiments of the invention, the nebulizer may dose the medicament to the user via a mouthpiece, though it is envisaged that atomized medicament could be dosed to the user through a sealing face mask.

The invention is further described by way of example only, with reference to the accompanying drawings, in which:

Figure 1 shows a schematic cross-section of an embodiment of the invention in use with the user inhaling;

Figure 2 shows a schematic cross-section of the embodiment of Figure 1 in use with the user exhaling; and

Figure 3 shows an enlarged schematic cross section view of a secondary chamber in the embodiment of Figure 1.

Referring to the figures, the atomizer includes a gas duct 6 which provides gas under pressure (show as a series of arrowheads in gas duct 6) from a compressed air source to a gas exit 4 within a jet head 3. The gas duct 6 passes through a wall of a reservoir 7 within which a substance to be atomised such as a medicament is held. A sleeve 8 is disposed around the jet head 3 and the gas duct 6. Passages are formed between the inner surface of the sleeve 8 and the outer surface of the gas duct 6 for leading the substance to be atomised from the reservoir 7 to a secondary reservoir 1, which has an exit to outlet 5 in the jet head adjacent to the gas exit 4.

For atomization of the substance to take place, gas exiting from the gas exit 4 passes close to the outlet 5. In a manner well known in the art, gas exiting from gas exit 4 flows at high speed into baffle bar 20, which is located generally at the bottom of a first chamber 9, and it is this collision of gas which generates the appropriate conditions in which to cause atomisation of medicament. The atomisation of medicament at outlet 5 causes substance to be atomised to be drawn from the reservoir 7, through the passage between the sleeve 8 and the gas duct 6, and up through secondary reservoir 1 to the outlet 5. The flow of pressurised air when it has rebounded off of baffle 20 atomises the substance as the sub-

stance leaves the outlet 5.

Further information on the atomisation procedure may be found in EP-A-627,266.

It is important that the substance is atomised into very fine droplets. In medical applications, the substance to be atomised is a drug for administering to a patient by lung deposition. The finer the droplets, the deeper into the lungs the drug will pass. This maximises the deposition of the drug.

The atomizer also has a housing portion 2 which vents to be outside by which atmospheric air may enter the atomizer. However, mounted on top of gas duct 6, and integral therewith is first chamber 9 which opens towards housing portion 2, but is separated therefrom by a first one way valve 10. First one way valve 10 is resiliently deformable, and configured so as to only open and allow air from housing portion 2 into the atomizer when the user is inhaling, and hence when a reduced or negative pressure is created in first chamber 9. This is the configuration of the device shown in Figure 1.

The atomizer is provided with a mouthpiece 11, which is in communication with a head space above reservoir 7, and with the first chamber 9, through which the user inhales and exhales. First chamber 9 has also located at its end remote from the gas exit 4 a second one way valve 12, which is configured to open only when the user is exhaling, and hence there is a positive pressure in first chamber 9, as shown in Figure 2.

First chamber 9 is separated from a second chamber 13 by a rigid sidewall 14, with sidewall 14 in one direction extending down towards and connecting with jet head 3, and in the other direction being also closed by second one way valve 12. Second chamber 13 is generally circular in cross section and bounded by sidewall 14, and is configured such that it also has an exit into secondary reservoir 1. Second one way valve 12 is made of a resilient material, and is configured so as to close both first chamber 9 and second chamber 13 simultaneously when there are no positive or reduced pressures in the atomizer.

In order that the atomizer is configured so as to function smoothly, it has been found preferable that the area of second one way valve 12 covering the first chamber 9 is substantially greater than the area of the second one way valve 12 covering the second chamber 13, and preferably is greater by a ratio of at least 10:1. If this is not the case, in the exhalation phase of use the pressure on the second one way valve may be too high to allow it to open properly.

Located on the side of the second one way valve 12 is a space 15, which is bounded by a resilient filter 16. Filter 16 is air permeable, though it could also be airtight in various embodiments.

It has also been found desirable in constructing the atomizer according to the invention that the entrance to the second reservoir 1 from the second chamber 13 and adjacent the end of sidewall 14 (marked as entrance 25 in the figures) has a relatively large diameter, and is preferably at least 5 mm across (though it can have any convenient cross section shape). This is to prevent liquid bridging across this area, for example, under the effect of surface tension. It is also preferred that at the entrance of the passages between sleeve 8 and gas duct 6 to secondary reservoir 1 (marked as entrance 26 on the figures) that these are relatively small diameter, and that these passages preferably have a cross-sectional area of 1.4 mm^2 or less.

Such a combination of dimensions has been found to improve the cut-off of atomization of product in use which occurs when the user exhales. In particular, the relatively large entrance dimension 25 and small entrance dimension 26 facilitate the urging of medicament out of second chamber 1 and back down the passages, and hence prevent unwanted atomization.

Figure 3 shows an expanded and simplified view of secondary chamber 1 showing entrances 25 and 26 in more detail.

In use, the atomizer according to the invention is connected to a compressed air source, which introduces a positive pressure through gas duct 6 into the atomizer, and through gas exit 4. This causes medicament in the vicinity of outlet 5 to be atomized in a known manner. When the user inhales (as shown in figure 1), air is drawn generally out of the atomizer via the mouthpiece 11, generating a reduced pressure in the device. In particular, first one way valve 10 is caused to open, and air is drawn in from the atmosphere. As it is drawn in, it generally captures atomized medicament, which is carried in the air stream towards mouthpiece 11 and out of the apparatus.

However, when the user has finished inhaling and subsequently exhales, this causes a positive pressure to be introduced into the atomizer, as is represented in figure 2. In particular, first one way valve 10 is sealed closed, but second one way valve 12 is caused to open. This in turn generates a positive pressure in second chamber 13, and this positive pressure causes expulsion of medicament from secondary reservoir 1, driving medicament back from outlet one down the channels in sleeve 8.

The effect of this is that as no medicament is to be found at this stage in the secondary reservoir 1 or outlet 5, no medicament is atomized during the exhaling part of the dosage cycle. This results in a saving in terms of the medicament used, since it is not atomized in the exhalation part of the cycle, and hence is not lost anywhere.

Any resultant extra positive pressure in the atomizer may be dissipated through resilient filter 16, which is air permeable.

Claims

1. An atomizer comprising an atomizer jet, the atomizer jet having a product outlet from which product

can be atomized, means for sourcing compressed air, a product reservoir, means for supplying the product from the reservoir to the outlet and a first chamber into which atomized product can diffuse, characterised in that the atomizer has means to prevent or stop the product from atomizing in response to a positive pressure in the atomizer.

2. An atomizer comprising an atomizer jet, the atomizer jet having a product outlet from which product can be atomized, means for sourcing compressed air, a product reservoir, a means supplying the product from the reservoir to the outlet and a first chamber into which atomized product can diffuse, characterised in that the atomizer has located between the product outlet and the reservoir a secondary reservoir which is in fluid connection with a second chamber, the second chamber being operable in response to a positive pressure in the atomizer to drive fluid from the secondary reservoir.

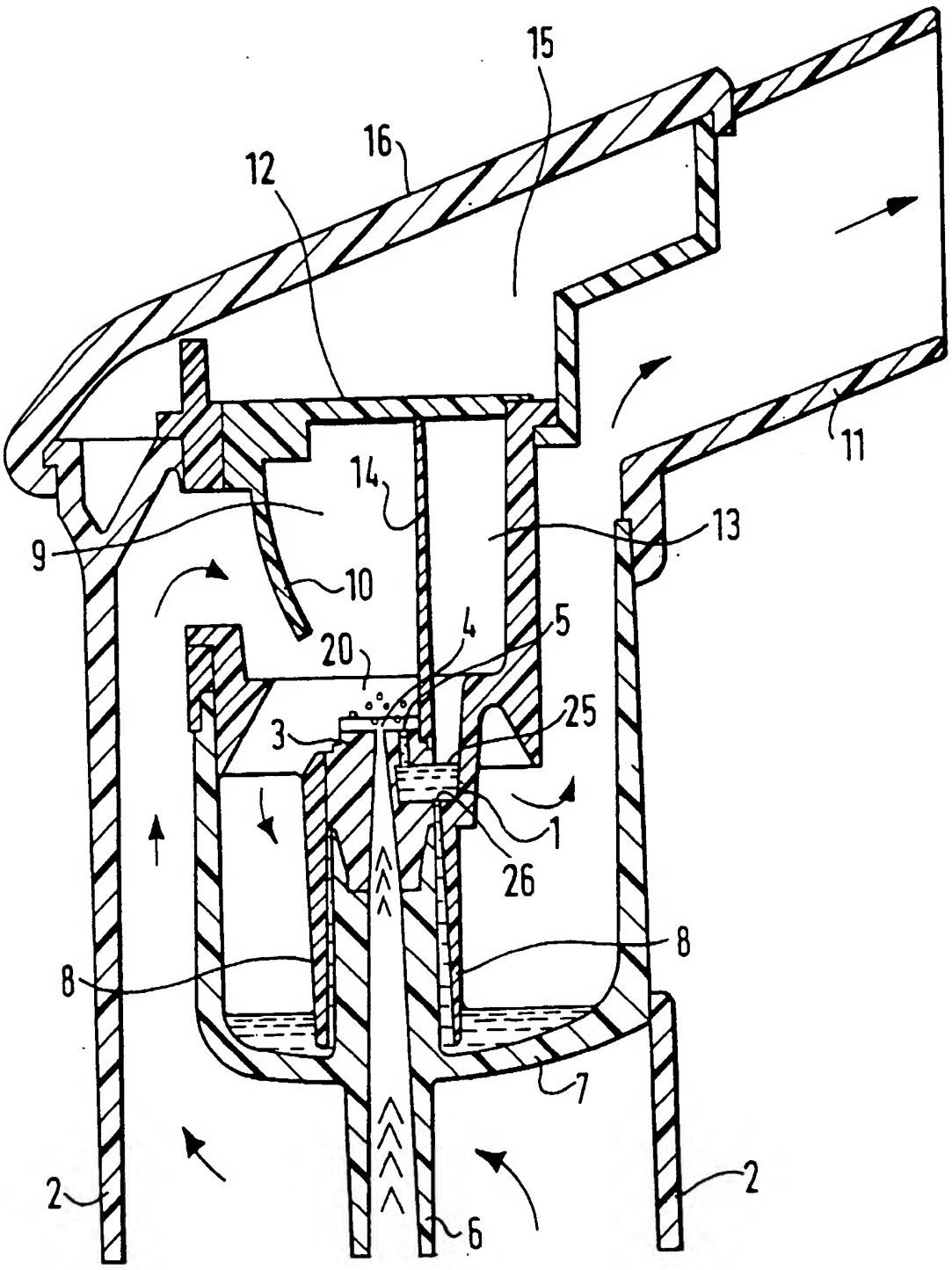

FIG.1.

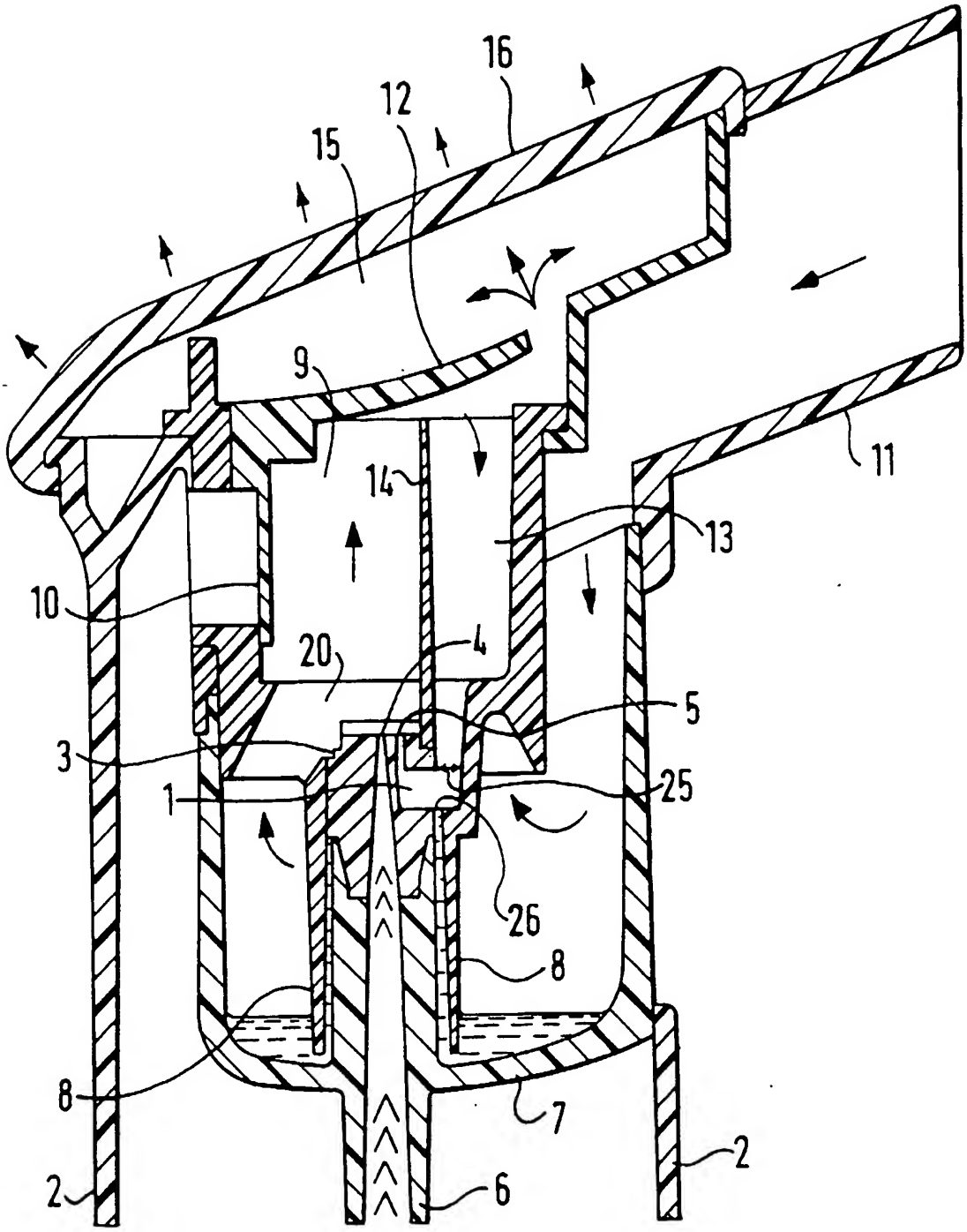

FIG.2.

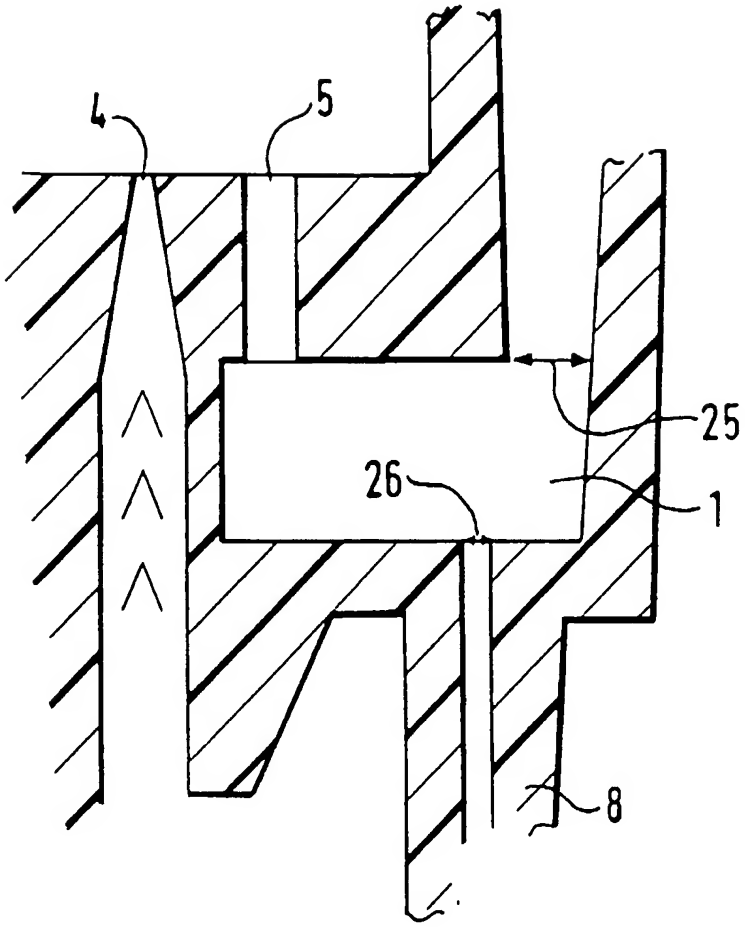

FIG.3.